DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA WITH SITTING HEIGHT, WEIGHT AND ESTIMATED AGE*

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(Figs. 57 to 72 incl.)

It is the purpose of the writer to present the results of some observations on growth in the infant female gorilla based upon a study of four dead and one living specimen. Each of the specimens is apparently referrable to Gorilla gorilla.

The observations have been confined to the growth changes in the bones of the hand as revealed by means of a radiographic examination, and to the sitting height, weight, dentition, and the estimated age. As the chronological age is estimated it naturally follows that it is subject to correction.

The Material.

The material observed consists of four dead specimens and one living female gorilla, "Janet Penserosa." Their ages range from about 9 to 42 months, and the sitting height (Crown-rump) from 37.5 to 63.5 centimeters. Janet Penserosa, the living specimen, is at the New York Zoological Park and at the present time appears to be in good physical condition.

Method of Presentation.

The observations will be presented in eight arbitrary stages of physical growth based upon the material observed. Starting with the smallest and youngest, each specimen will be described

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separately in the order of its sitting height and dentition. Observations which will serve to show growth changes in the same living individual were made upon Penserosa at four successive periods of time. In conclusion a summary of the observations will be tabulated in a composite table.

Specimen No. 1.

History.

The preserved body of this specimen (C. A. 1105) is in the collection of the Department of Comparative Anatomy at the American Museum of Natural History.

This young gorilla was captured by natives in the Cameroon of West Central Africa sometime during the spring of 1928 and was brought to Duala on the west coast of Central Africa. It was purchased at this port by a sea captain and taken on board a freight steamer to Brooklyn, N. Y., arriving at the latter port about July 22, 1928. During the voyage at sea, about twelve weeks, its food consisted of bananas (plantain) and diluted condensed milk. It had apparently become infected on board ship, since at the time of arrival it was suffering from a "common cold," according to the history given by the ship's captain. The captain had treated the suffering baby gorilla for a "cold" with home remedies and simple cough mixtures for about a week, after which the writer was called to examine the sick gorilla. On the night of July 29, 1928, an emaciated infant female gorilla was seen gasping for breath, with a mucopurulent discharge from the eyes and nostrils. Its gums were tender and swollen as the result of teething. The pharynx was congested and contained a mucopurulent exudate. Respiration was labored and painful. On auscultation increased sibilant bronchial tones were heard while on percussion dullness over the upper right lobe was present, with tenderness and pain in the lower parts of the chest wall. A diagnosis of broncho-pneumonia and pleurisy was made. Since the infant gorilla was very weak and unable to move about or sit up, a very unfavorable prognosis was made. It died the next morning, on July 30, 1928. Cause of death: Broncho-pneumonia and complications following a "common cold."

No autopsy was performed, but instead the remains were sent to the Department of Comparative Anatomy at the American Museum of Natural History in New York City, where it is now known as C. A. 1105. It is hoped that the viscera will be examined for gross pathological changes whenever the specimen may be dissected. It is believed that this is the youngest and

smallest specimen of an infant female gorilla in the United States.

The weight of its body at the time of death was 8½ pounds, or 3.86 kg. Its sitting height was 37.5 cm. Schultz[1] has reported as follows on this preserved specimen: "The preserved body of a small gorilla at the American Museum of Natural History (C. A. 1105) has eight incisors and four molars and weighs 4.5 kg. . . . its sitting height measures only 368 mm. and its head length 115 mm. as compared with the corresponding dimensions of Famelart's gorilla, etc." The writer wishes to call attention to an apparent discrepancy in the weight of the specimen as given by Schultz, i. e., 4.5 kg. and the weight of 3.86 kg. as recorded in this paper. This difference in weight can readily be explained by stating that the weight of 3.86 kg. was made before the specimen had been injected and placed in preserving fluid.

Since this gorilla was emaciated and evidently underweight as the result of disease, its weight cannot be considered as normal.

TABULATION OF OBSERVATIONS ON GORILLA NO. 1.

Estimated Age	9 to 12 months.
Sitting Height	37.5 cm. (According to Schultz, 36.8 cm.)
Weight	3.86 kg. (8½ pounds.)
Dentition	12 teeth. 4 upper and 4 lower incisors; 2 upper and 2 lower premolars.

Radiographic Record of the bones of the hand (Figs. 57-58).

Radius	Slight bowing.
Ulna	Relatively straight.
Distal Epiphyses of Radius	Visible in right and left hand.
Distal Epiphyses of Ulna	Visible in right hand only.
Carpal Bones	Os Capitatum (Magnum) and Os Hamatum (Unciform) visible.
Proximal Epiphyses of First Metacarpal	None visible.
Distal Epiphyses of Metacarpal Bones	Spherical and porous in appearance, and present in 2-3-4. The third is the largest.
Proximal Epiphyses First Phalanx	2-3-4 visible.
Proximal Epiphyses Second Phalanx	None visible.
Proximal Epiphyses Third Phalanx	None visible.

The above observations represent the stage of growth and development of the parts examined at the time of this gorilla's death.

Specimen No. 2.

History.

An infant female gorilla was obtained from natives by the captain and steward of a freight steamer at a port on the west coast of Central Africa on May 28, 1930. It was a very young specimen, which was teething at the time of purchase and had been quite ill during the sea voyage. The diet consisted of diluted whole dried milk and bananas. During the trip it was kept in a hot, poorly ventilated room, with one chimpanzee as a companion. This specimen arrived at Brooklyn, New York, on the night of August 5, 1930. Mr. Ellis S. Joseph, an animal importer and dealer, saw the weak, ailing infant gorilla on the night of August 6, 1930, and received permission to take it to his home for medical treatment. He described it as being in a state of exhaustion since it was panting for air in the hot, stifling atmosphere of a cabin room which had been fumigated. A denuded area the size of a half dollar, caused by the bite of the chimpanzee companion, was found on the left side of the head over the parietal bone.

The writer was called and saw the ailing infant gorilla, named "Trixie," at ten o'clock at night. It was found lying on its back in a weakened condition, unable to get up except with the greatest difficulty, when it would attempt to sit up only to fall to one side from sheer weakness. It seemed to be most comfortable lying on its back. Respiration was irregular, at first deep and labored, then gradually becoming weaker and almost fading out, then the respiration would become deeper again. A slight mucopurulent discharge was present from both eyes and nostrils, indicating the presence of a "common cold." Reddened tender gums with teeth in the process of eruption were present, indicating that the milk dentition was being completed.

A diagnosis of myocardial degeneration resulting from exhaustion and a "common cold" was made. Prognosis was very unfavorable as the gorilla was practically in a moribund state. There were several attacks of cardiac weakness during the night, with severe dysponea. Artificial respiration was resorted to twice with only slight temporary relief. At six o'clock in the morning of August 7, 1930, the creature died without a struggle during an attack of cardiac failure.

No autopsy was performed. The body was embalmed with 10% formalin. The writer is indebted to Mr. Ellis S. Joseph

for permission to have radiographs made and to make the observations tabulated below.

The embalmed body was received by Dr. Adolph Schultz of Johns Hopkins University from Mr. Joseph on November 12, 1930, at the New York Zoological Park hospital.

TABULATION OF OBSERVATIONS ON GORILLA NO. 2.

Estimated Age	14 to 16 months.
Sitting Height	41 centimeters.
Weight	4.66 kg.
Dentition	20 teeth. All incisors (8) and first premolars (4) completely erupted. The canines (4) and 2 upper second premolars in process of eruption. The two lower second premolars erupted.

Radiographic Record of the bones of the hand. Volar aspect. (Figs. 59-60).

Radius	Bowing present.
Ulna	Relatively straight.
Distal Epiphyses of Radius	Right and left visible.
Distal Epiphyses of Ulna	Right and left visible. (Left is larger than right.)
Carpal Bones	Os Capitatum (Magnum) visible. Os Hamatum (Unciform) visible.
Proximal Epiphyses of First Metacarpal	Both visible, one in each hand. (Small).
Distal Epiphyses of Metacarpal Bones	Large, spherical and porous. All four visible. 2-3-4-5.
Proximal Epiphyses First Phalanx	2-3-4-5. Flat, ovoid, webbed discs.
Proximal Epiphyses Second Phalanx	2-3-4. Flat, ovoid, webbed discs.
Proximal Epiphyses Third Phalanx	None visible.

SPECIMEN NO. 3.

History.

The third infant female gorilla of this series belongs to Dr. J. H. McGregor of Columbia University, from whom permission to examine it was obtained. He secured this young specimen in the Cameroon district at Vimili in West Central Africa during December, 1929. It was suffering from an attack of pneumonia, to which it succumbed in January, 1930. After embalming, the remains were brought to New York.

Tabulation of Observations on Gorilla No. 3.

Estimated Age	16 to 18 months.
Sitting Height	43.5 centimeters.
Weight estimated	5.2 kg.*
Dentition	20 teeth. Full set milk teeth.

Radiographic Record of the bones of the hand. (Figs. 61-62.)

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Radiograph poor.
Distal Epiphyses of Ulna	Radiograph not clear.
Carpal Bones	Os Capitatum (Magnum), Os Hamatum (Unciform).
Proximal Epiphyses of First Metacarpal	One visible in each hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed 2-3-4-5 visible.
Proximal Epiphyses First Phalanx	All visible as ovoid discs. 2-3-4-5.
Proximal Epiphyses Second Phalanx Proximal Epiphyses Third Phalanx	On account of the contraction of the hands and hardening by formalin, the radiograph is not satisfactory.

Specimen No. 4.

History.

The body of the fourth specimen in this series is in the collection of the Department of Comparative Anatomy of the American Museum of Natural History in New York City and is labelled C. A. 1216. On account of the rufous color of the hair it is apparently referrable to Gorilla gorilla castaniceps.

It arrived on board a freight steamer, from a port on the west coast of Central Africa, at Brooklyn, New York, about July 1, 1929, and was obtained by a dealer in animals. The dealer had it about ten days, attempting to cure a profuse diarrhoea from which the gorilla had apparently been suffering during the voyage and after its arrival in Brooklyn. The writer saw the ailing infant female gorilla during the late afternoon of July 11, 1929, and found it to be extremely emaciated, anemic and weak, with a profuse diarrhoea and virtually moribund. Diagnosis: Enteritis—exact cause not determined; probably parasitic.

The prognosis was very unfavorable. Death occurred before midnight. As the remains were sent to the American Museum of Natural History, no autopsy was made.

*The weight of the embalmed specimen is 13¼ pounds and by allowing 2 pounds for the weight of the preserving fluid, its weight is estimated at 11½ pounds or 5.2 kg.

Tabulation of Observations on Gorilla No. 4.

Estimated Age	24 to 30 months.
Sitting Height	53 centimeters.
Weight	(22 pounds) 10.9 kg. (Underweight-emaciated.)
Dentition	20 teeth. Full set of milk teeth. The canine teeth were quite large and protruded beyond the incisors.

Radiograph Record of the bones of both hands. (Figs. 67-68).

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Visible and definite in right and left hand.
Distal Epiphyses of Ulna	Right and left visible.
Carpal Bones	Os Capitatum (Magnum), Os Hamatum (Unciform), Os Navicular (Scaphoid), Os Triquetrum (Cuneiform) Os Multangular Major (Trapezium).
Proximal Epiphyses of First Metacarpal	Both present—very definite—one in each hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed. 2-3-4-5 all visible and very definite.
Proximal Epiphyses First Phalanx	1-2-3-4-5. Ovoid, flat, webbed discs visible in both hands.
Proximal Epiphyses Second Phalanx	2-3-4-5. Ovoid, flat, webbed discs.
Proximal Epiphyses Third Phalanx	1-2-3-4-5. Ovoid, flat, webbed discs.

Specimen No. 5.

The fifth specimen of this series is the young female gorilla at the New York Zoological Park, known as "Janet Penserosa."

History.

Early in the summer of 1928, Rev. W. Reginald Wheeler sailed from the port of Duala situated on the west coast of Central Africa, with three baby gorillas (two females and a male) and a baby white-faced female chimpanzee. The gorillas were apparently referrable to Gorilla gorilla, the chimpanzee to *Pan chimpanzee.*

They had been in captivity for about three months before leaving Duala for New York via France. Their food consisted of milk from a nursing bottle, some bananas and white bread.

Two of the gorillas died and were buried at sea on the way from Duala to Bordeaux while the remaining infant female gorilla suffered from a "cold" and a digestive disturbance. As

soon as they arrived at Bordeaux both the gorilla and the chimpanzee were taken to the Jardin des Plantes in Paris, where they were nursed for several days while arrangements were being made to bring them to New York.

During the night of October 30, 1928, they landed at Pier 59, North River, on board the S. S. *Olympic* of the White Star Line. At 10:30 A. M. the next morning, October 31, 1928, an emaciated sick infant gorilla and chimpazee were received by Mr. William White Niles, Secretary of the New York Zoological Society, in order that they might be properly taken care of and protected.

Since both of the apes were in a very poor condition, suffering from the effects of the journey, a severe cold and an unsightly skin disease (dermatitis), they were placed in charge of the writer by Dr. W. Reid Blair, Director of the New York Zoological Park.

At noon they were taken from the pier and arrived at the Hospital in the New York Zoological Park at one o'clock. Examination revealed that both were extremely emaciated and suffered from an intense itch accompanying Dermatitis which caused them to scratch themselves incessantly. Their skin was completely covered with rough, dry, scaly, encrusted tenaceous masses of a honey-like, purulent character. A mucopurulent discharge from both eyes and nostrils was present. The eyelashes were stuck together with a purulent mass while the borders of the lids were granular. The conjunctivae were reddened and the eyes contained small flaky, purulent masses. In spite of their condition both apes were fairly active. The gorilla would refuse to come to anyone and would bite, squirm and cry if anyone attempted to separate her from the chimpanzee. She clung firmly to the chimpanzee and the chimpanzee in turn "mothered" and protected the baby gorilla. The gorilla weighed 17¼ pounds (7.84 kg.). The chimpanzee weighed 18 pounds (8.18 kg.).

The right nostril of the gorilla was completely occluded and the borders of both nostrils were eroded. A denuded, ulcerated area was present on the right thigh, and other parts of the body were tender. An examination of the mouth was very difficult due to the resistance of the gorilla, which would fight by biting and screaming. Its scream resembled the cry of an irritated angry child. All of the incisor and canine teeth were visible, and since the canine teeth were present it is very probable that she was in possession of a full set of 20 milk teeth. The height of the canine teeth was not much above that of the incisor teeth.

Comfortable quarters in one of the sanitary cages at the Hospital were provided for the patients, with fresh clean straw

as bedding. They were fed some oranges and bananas soon after arrival.

The occluded nostrils were cleared with cotton and a mild antiseptic solution, while their eroded margins were covered with some carbolated petrolatum.

There was some improvement until December 26, 1928, when bronchitis and bronchopneumonia developed and lasted until the middle of January, 1929. From that period on improvement was steady, as indicated by the weight record.

Table showing estimated age and weight record of infant female Gorilla "Janet Penserosa."

Age—Estimated	Date weighed	Weight—Kilograms
.....	10/31/28	7.84
20 months	11/ 9/28	8.93
.....	11/18/28	8.75
21 months	12/ 4/28	10.00
.....	12/26/28	10.34
22 months	1/15/29	10.34
23 months	2/ 5/29	10.68
.....	2/15/29	11.12
.....	3/28/29	11.13
25 months	4/13/29	11.47
26 months	5/ 1/29	11.70
.....	5/22/29	11.53
27 months	6/ 6/29	12.30
.....	6/24/29	12.95
28 months	7/ 5/29	13.18
.....	7/20/29	13.56
29 months	8/12/29	13.86
.....	8/30/29	14.10
30 months	9/10/29	15.00
.....	9/30/29	15.00
31 months	10/11/29	15.34
32 months	11/10/29	16.13
33 months	12/ 5/29	16.93
.....	12/27/29	17.60
34 months	1/21/30	18.30
35 months	2/13/30	18.86
36 months	3/ 7/30	19.54
.....	3/18/30	19.43
.....	3/30/30	19.77
37 months	4/21/30	20.45
38 months	5/ 9/30	20.34
39 months	6/ 2/30	21.36
40 months	7/10/30	22.20
.....	7/24/30	22.70
41 monthe	8/12/30	23.63
42 months	9/ 2/30	23.80
43 months	10/ 1/30	23.90
.....	10/20/30	24.09
45 months	12/ 9/30	24.65

Without going into the details of the care of the infant gorilla, it is of significance to note that it was irradiated with ultraviolet light from a mercury vapor lamp, at a distance of four to five feet for from 20 to 40 minutes daily during November and December, 1928 and the first five months of 1929. The only visible external effect seemed to be that the hair coat improved in appearance. As the skin on the gorilla's face is black no visible effect on its skin was observed. The bare face of the chimpanzee took on a tan as its skin is light and hairless. After May 28, 1929, irradiation was discontinued because they were kept out of doors each day from that date on.

Their nutritional requirements have been adequately provided for, as can be seen from their diet. The feeding schedule has remained the same from the time of arrival to the present date. Their food is plain and wholesome. It was not necessary to resort to the use of specially cooked or expensive foods for these apes at any time in order to maintain them in good condition.

Feeding Schedule.

8:00 A.M. Two to three cups diluted condensed milk.
Two teaspoonfuls whole dried milk.
One to two teaspoonfuls of a baby wheat food for flavoring.
Two raw eggs.

The above mixture is beaten with an egg beater and the gorilla is allowed to take as much as it desires.

9:00 A.M. Three teaspoonfuls of cod liver oil with one to two teaspoonfuls of a mixture of finely ground bone and blood meal.

12:30 P.M. Bananas with skins on. All anthropoid apes like to eat the inner white lining (the endocarp) of banana peels, especially of bananas which contain a tinge of green coloring in the skins. They prefer a banana which to the human has a slightly acrid taste rather than a sweet, fully ripe banana.
Oranges are an important item in the diet. Two or three oranges are fed daily. At times orange juice alone is given, about a cupful at a time.
Raw carrots.
Lettuce.
Boiled potatoes with skins on.

Simple rice pudding with a liberal supply of raisins.
Apples.
Celery.
Stale rye bread.
When available, the leaves and green burrs of the sweet gum tree (*Liquidambar styraciflua*) are enjoyed by the gorilla and chimpanzee. Young oak (*Quercus*) or wild cherry (*Betula lenta*) leaves are also relished.
At times they have eaten small quantities of cheese.
While they like peanuts we have not fed them except on rare occasions.

5:00 P.M. The evening meal is the same as the morning meal.

The following tabulations are made for comparison with the other observations in this series.

"Janet Penserosa." Gorilla No. 5.
November 3, 1928.

Estimated Age	18 to 20 months (Brandes[2], Krogman[3] quoting Keith).
Sitting Height	No record for this date.
Weight	7.84 kg.
Dentition (Noback[4])	20 teeth. Since the canines were present a full set of milk teeth is assumed to have been present.

Radiographic Record of the bones of the right hand only. (Figs. 63-64.)

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Right visible.
Distal Epiphyses of Ulna	Right visible.
Carpal Bones	Os Capitatum (Magnum) and Os Hamatum (Unciform) show marked centers of ossification. Os Multangular major (Trapezium) and Os Triquetrum (Cuneiform) not so pronounced as first two and Os Navicular (Scaphoid) has a faint center of ossification.
Proximal Epiphyses of First Metacarpal	Visible in right hand. No record of left hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed. Visible in 2-3-4-5.
Proximal Epiphyses of First Phalanx	Ovoid, flat, webbed discs in 2-3-4-5.
Proximal Epiphyses of Second Phalanx	Ovoid, flat, webbed discs in 2-3-4-5.
Proximal Epiphyses of Third Phalanx	Negative; not clear.

March 10, 1929.

Estimated Age.....24 to 26 months.
Sitting Height.....47.5 centimeters.
Weight .....11.1 kg.
Dentition .....20 teeth. A full set of milk teeth. The canines larger than the incisors.

Radiographic Record of the bones of the left hand. (Fig. 65.)

Radius .....No record.
Ulna .....No record.
Distal Epiphyses of Radius...Visible.
Distal Epiphyses of Ulna.....Visible.
Carpal Bones .....Os Capitatum (Magnum), Os Hamatum (Unciform), Os Triquetrum (Cuneiform), Os Navicular (Scaphoid), Multangular major (Trapezium).
Proximal Epiphyses of First Metacarpal.....One visible.
Distal Epiphyses of Metacarpal Bones .....Spherical and webbed. 2-3-4-5 visible.
Proximal Epiphyses of First Phalanx.....Flat, ovoid, webbed discs. 1-2-3-4-5.
Proximal Epiphyses of Second Phalanx.....Flat, ovoid, webbed discs. 2-3-4-5.
Proximal Epiphyses of Third Phalanx .....Flat, ovoid, webbed discs in 2-3-4-5.

March 2, 1930.

Estimated Age.....34 to 38 months.
Sitting Height .....54.5 centimeters. March 18, 1929.
Weight .....19.43 kg.
Dentition .....24 teeth. The four first permanent molars erupted during February and March, 1930. None of the milk teeth have been shed.

Radiographic Record of the bones of both hands. (Figs. 69-70.)

Radius .....Bowed.
Ulna .....Relatively straight.
Distal Epiphyses of Radius...Visible in right and left hand.
Distal Epiphyses of Ulna.....Visible in right and left hand.
Carpal Bones .....Os Capitatum (Magnum), Os Hamatum (Unciform), Os Triquetrum (Cuneiform), Os Navicular (Scaphoid), *Os Multangular major (Trapezium), *Os Multangular minor (Trapezoid), *Os Lunatum (Lunar), *Os Pisiforme (Pisiform), *Os Centralia (Centrale).
Proximal Epiphyses of First Metacarpal.....One visible in each hand and very definite.

*Appeared since March 10, 1929. The gorilla normally has eight carpal bones (Sonntag[5]), therefore the presence of nine carpal bones in Penserosa is apparently unusual.

March 2, 1930 (*Cont.*)

Distal Epiphyses of Metacarpal Bones ..... Spherical, webbed—2-3-4-5 visible. Fusion with metacarpal bones is visible in right hand.

Proximal Epiphyses First Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.

Proximal Epiphyses Second Phalanx ..... Flat, ovoid, webbed discs in 2-3-4-5.

Proximal Epiphyses Third Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.

July 25, 1930.

Estimated Age ..... 40 to 42 months.
Sitting Height ..... 63.5 centimeters.
Weight ..... 24 kg. September 3, 1930.
Dentition ..... 24 teeth. 1 set of milk teeth 20
First permanent molars 4
24

Radiographic Record of the bones of both hands. (Figs. 71-72.)

Radius ..... Bowed.
Ulna ..... Relatively straight.
Distal Epiphyses of Radius ... Visible in right and left hand.
Distal Epiphyses of Ulna ..... Visible in right and left hand.
Carpal Bones ..... No fusion between Centralia and Navicular.
Proximal Epiphyses of First Metacarpal ..... Same as March 2, 1930.
Distal Epiphyses of Metacarpal Bones ..... Spherical and webbed in 2-3-4-5. Fusion with metacarpal bones present in both hands.
Proximal Epiphyses First Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.
Proximal Epiphyses Second Phalanx ..... Flat, ovoid, webbed discs. 2-3-4-5.
Proximal Epiphyses Third Phalanx ..... Flat, ovoid, webbed discs. 1-2-3-4-5.

LENGTH, SITTING HEIGHT AND SPAN.
"Janet Penserosa."

	Length Crown-Heel	Sitting Height Crown-Rump	Span Lying on back—arms outstretched.
May 18, 1929	72 cm.	47.5 cm.	106 cm.
March 18, 1930	86 cm.	54.5 cm.	122 cm.
September 3, 1930	No record.	63.5 cm.	130 cm.

The following composite table on pages 150-151 contains a summary of the observations on the appearance of centers of ossification for the carpal bones and epiphyses in the hands of five infant female gorillas as determined by radiographic examination.

SUMMARY.

1. All the carpal bones (9), in the wrists of the living female gorilla under observation, were present before the fourth year. One other female gorilla, about five years of age, which will be reported on later, has been radiographed and all of its (8) carpal bones were present.

2. The development of the carpal bones, as shown in this study is very rapid in comparison with the human hand where the carpal bones are not normally present until about the tenth to the twelfth year. (Baldwin[6]).

3. The epiphyses of the bones of the hand appeared very early. Fusion had begun to take place between the metacarpal bones and their distal epiphyses at about the third year, the same time that the first permanent molars appeared.

4. The first permanent molar teeth (six-year molars of man) appeared at about the third year.

5. The total body weight of the living infant female gorilla increased steadily from 7.84 kg. on October 31, 1928, to 24.09 kg. on October 20, 1930. Its weight on arrival was less than the average weight of a one year old human female but after two years the weight was greater than the average weight of an eight year old child. (Davenport[7]).

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"Briefly summarizing the results of our investigations we may use the following data to determine or fix the age (Altersstufen) of the gorilla, the lower values to be used for the female."

Age	Weight	Dentition
1 year	6 to 7 kg.	20 milk teeth, canines still short.
1½ "	9 to 12 kg.	Canines and 2 milk molars grow to their full height.
2 "	15 to 18 kg.	M_1 erupts, and grows to full height.
2½ "	20 to 23 kg.	Shedding of incisors.
3 "	26 to 30 kg.	M_2 erupts, premolars shed.
4 "	40 to 50 kg.	Canines shed, M_3 erupts, color change in the hair,
5 "	70 to 80 kg.	particularly in the dorsal region.
6 "	80 to 100 kg.	

Dr. Gustav Brandes, Director of the Dresden Zoological Garden, in a communication to the writer, believes Penserosa to be six months younger than her estimated age. He bases his estimate on the assumption that the first permanent molar erupts in the gorilla at 2½ years of age, as indicated in his formula quoted above.

Krogman[3] states that "the deciduous teeth, completely erupted, according to Keith, by the end of the second year in the anthropoids, erupt, variably, in the order of central and lateral incisors, first and second (pre?) molars, and canine. The first molar is the first permanent tooth to erupt, presumably at or shortly before the age of four years."

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A SERIES OF SIXTEEN RADIOGRAPHS SHOWING THE DEVELOPMENT OF THE DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA

Radiographs made by L. T. Le Wald, M.D.,
Professor of Roentgenology, Medical College, New York University

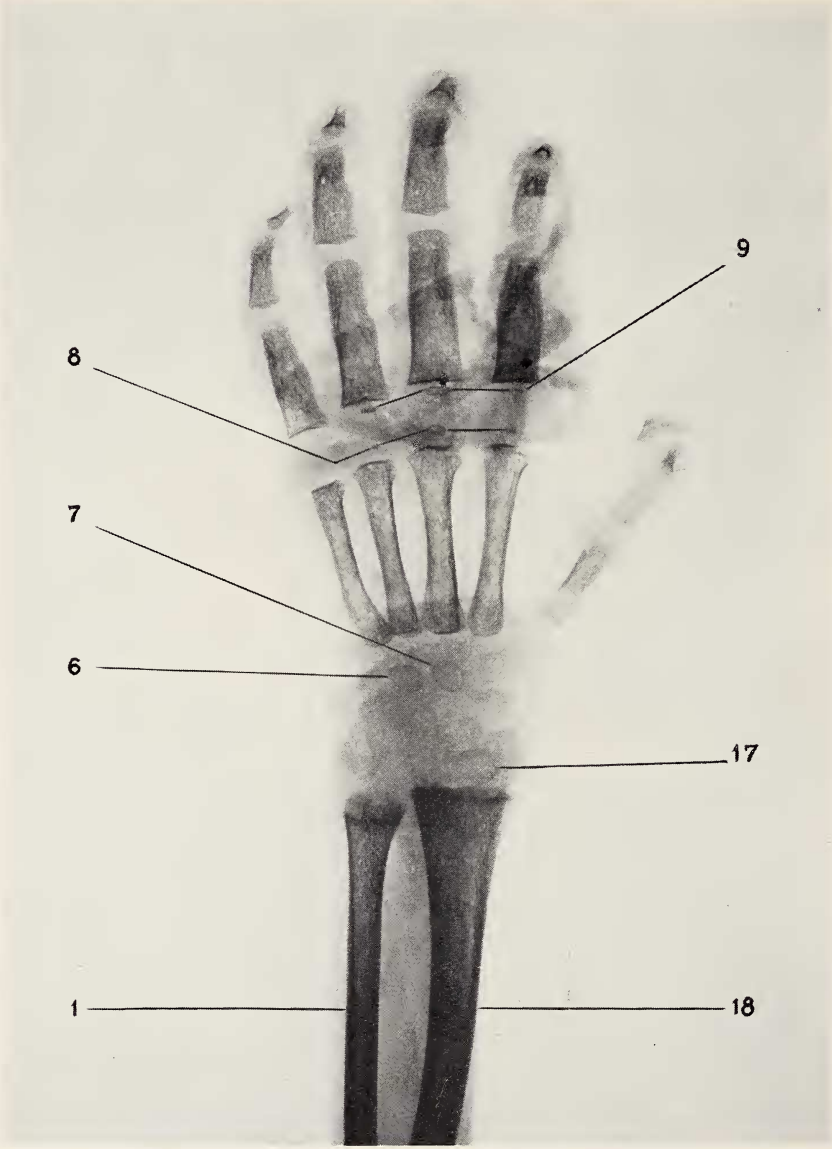

Fig. 57. Left Hand. Dorsal Aspect. 1. Ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4 metacarpal bones, the third being the largest. 9. Proximal epiphyses of the first phalanx in 2-3-4, the third being the largest. 17. Distal epiphyses of radius. 18. Radius.

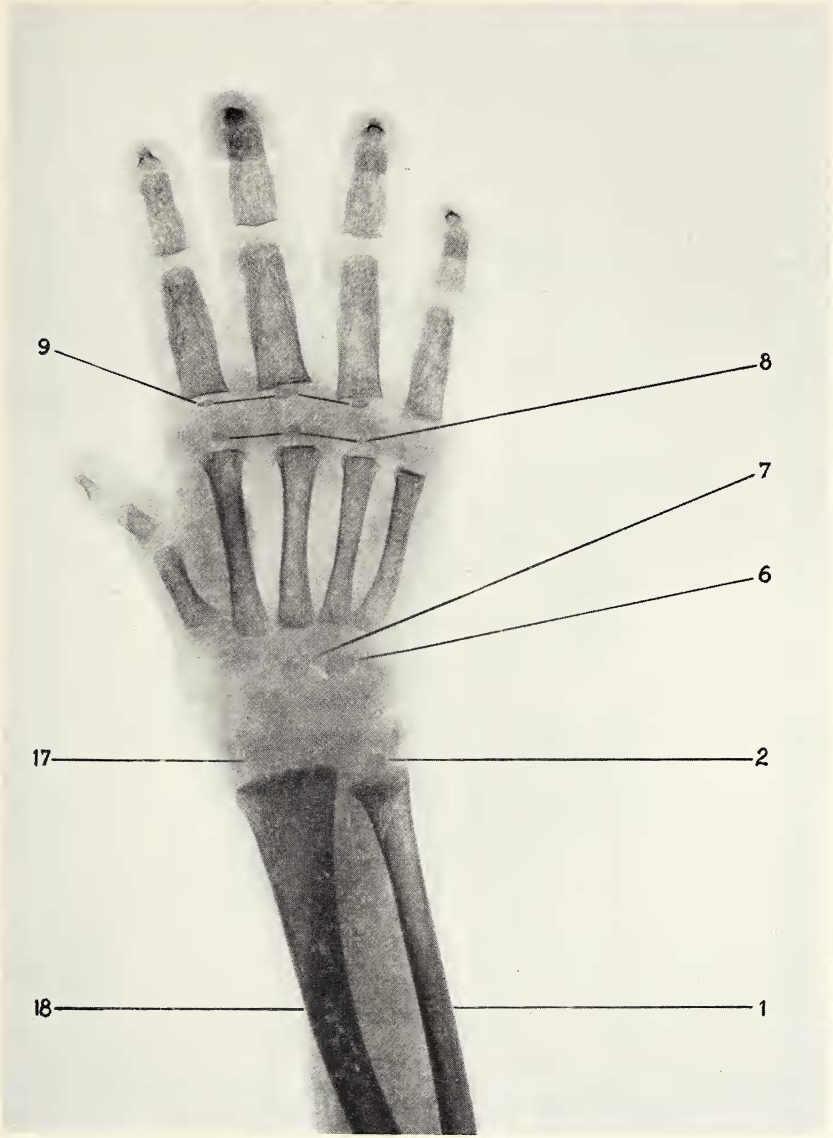

Fig. 58. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4 metacarpal bones, the third being the largest. 9. Proximal epiphyses of first phalanx in 2-3-4, the third being the largest. 17. Distal epiphyses of radius. 18. Radius.

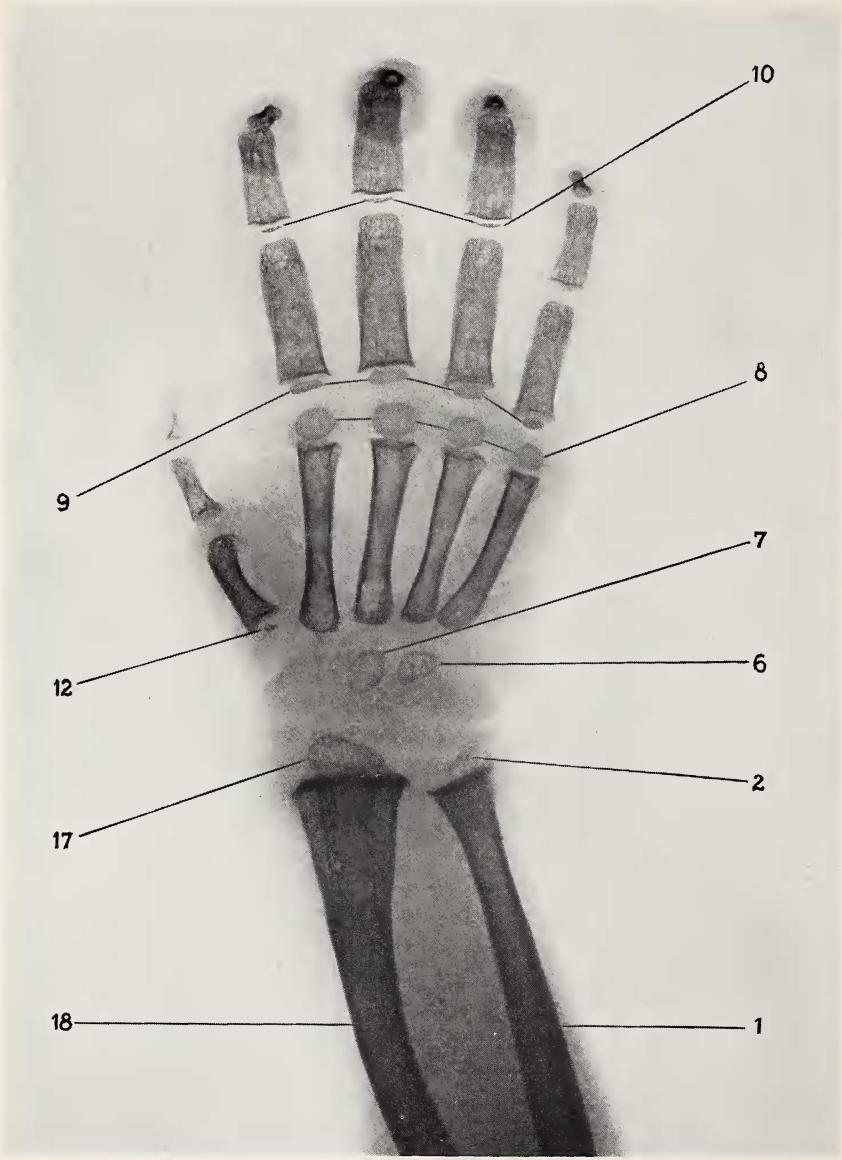

Fig. 59. Left Hand. Volar Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. In this stage the epiphyses are larger and spherical. 9. Proximal epiphyses of first phalanx in 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4. 12. Proximal epiphyses of first metacarpal. 17. Distal epiphyses of radius. 18. Radius.

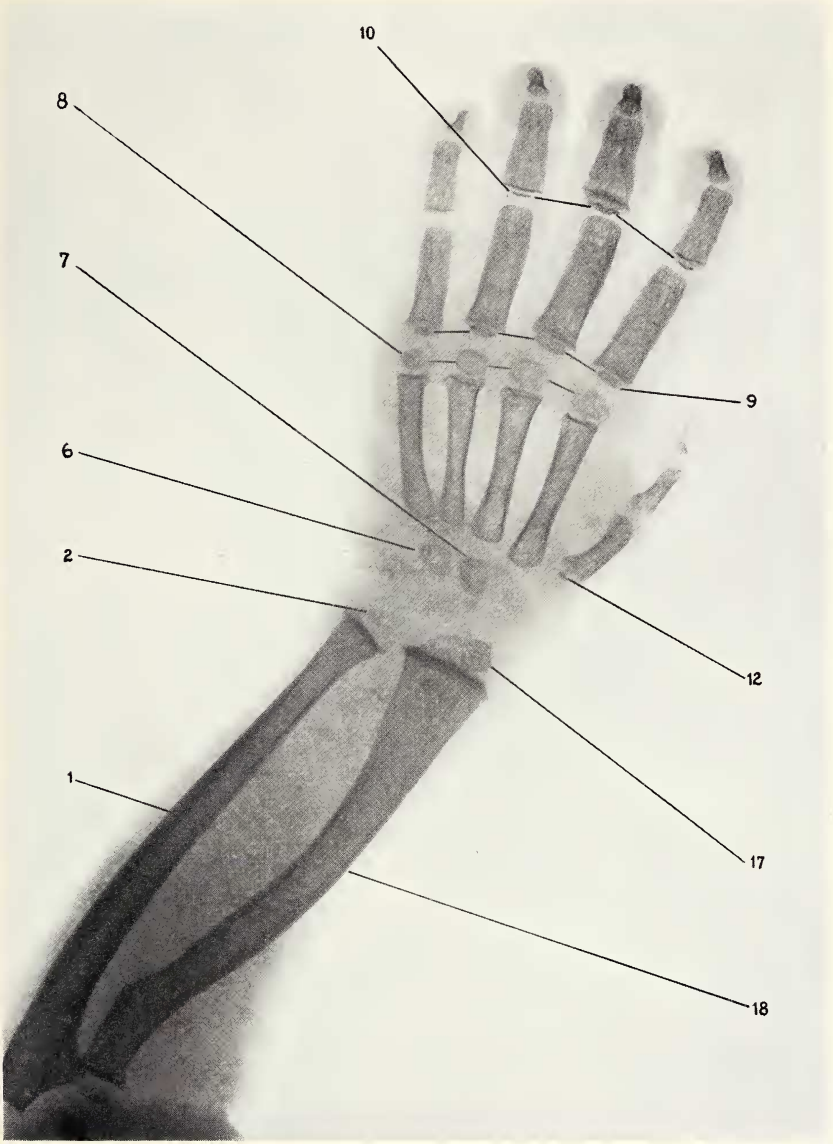

Fig. 60. Right Hand. Volar Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. The epiphyses are larger and spherical. 9. Proximal epiphyses of first phalanx 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4. 12. Proximal epiphyses of first metacarpal. 17. Distal epiphyses of radius. 18. Radius.

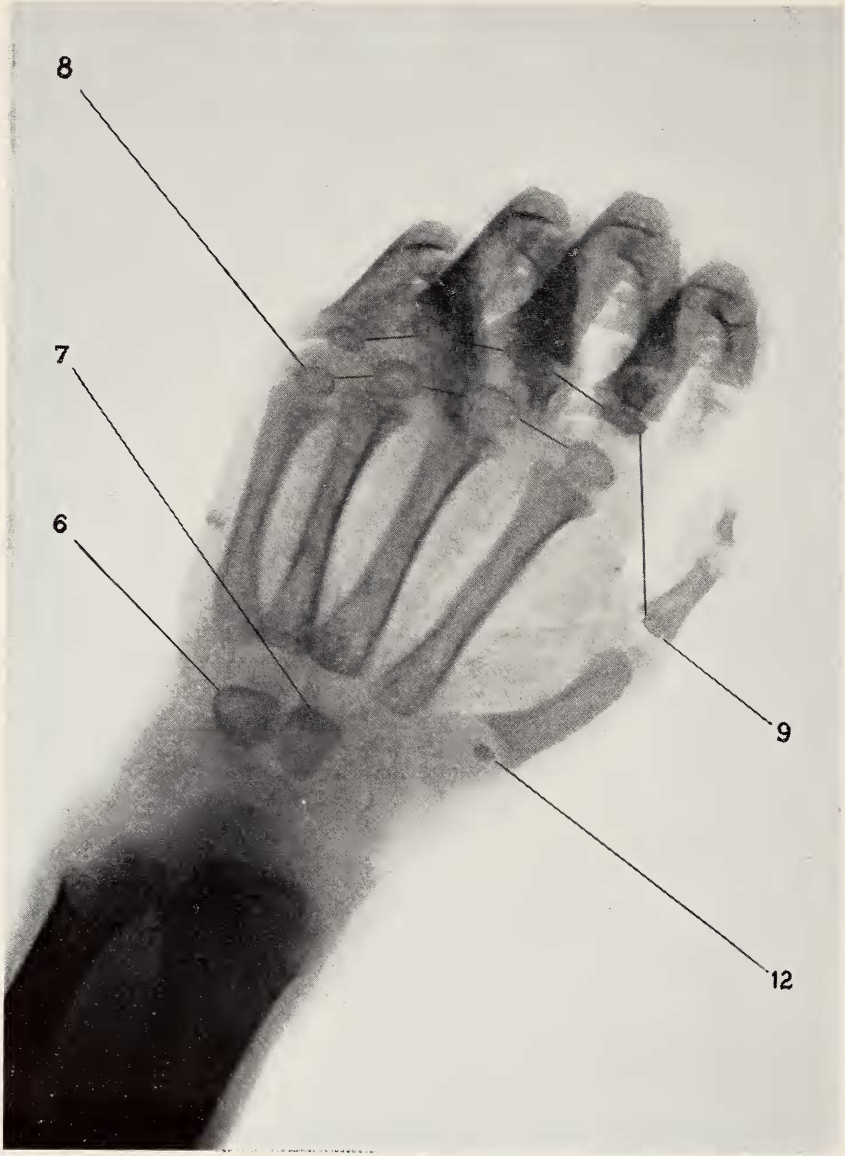

Fig. 61. Left Hand. Dorsal Aspect. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal.

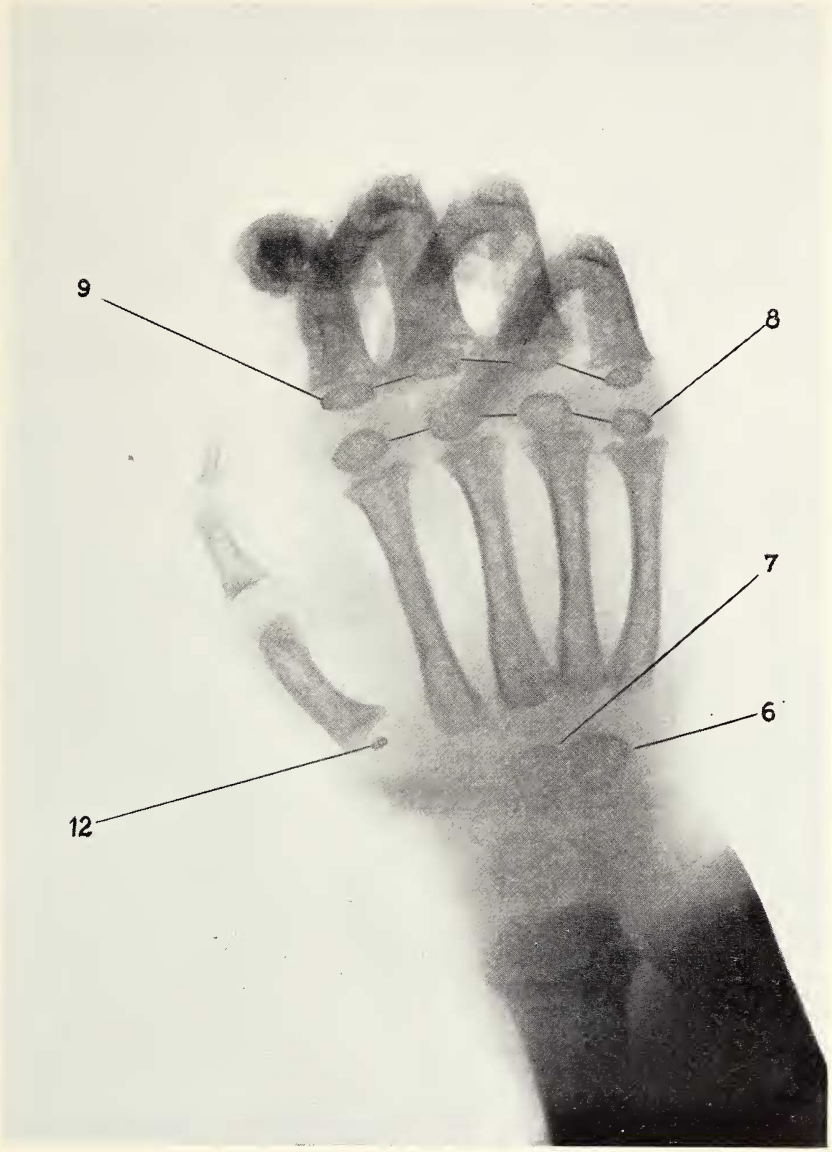

Fig. 62. Right Hand. Dorsal Aspect. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 12. Proximal epiphyses of first metacarpal.

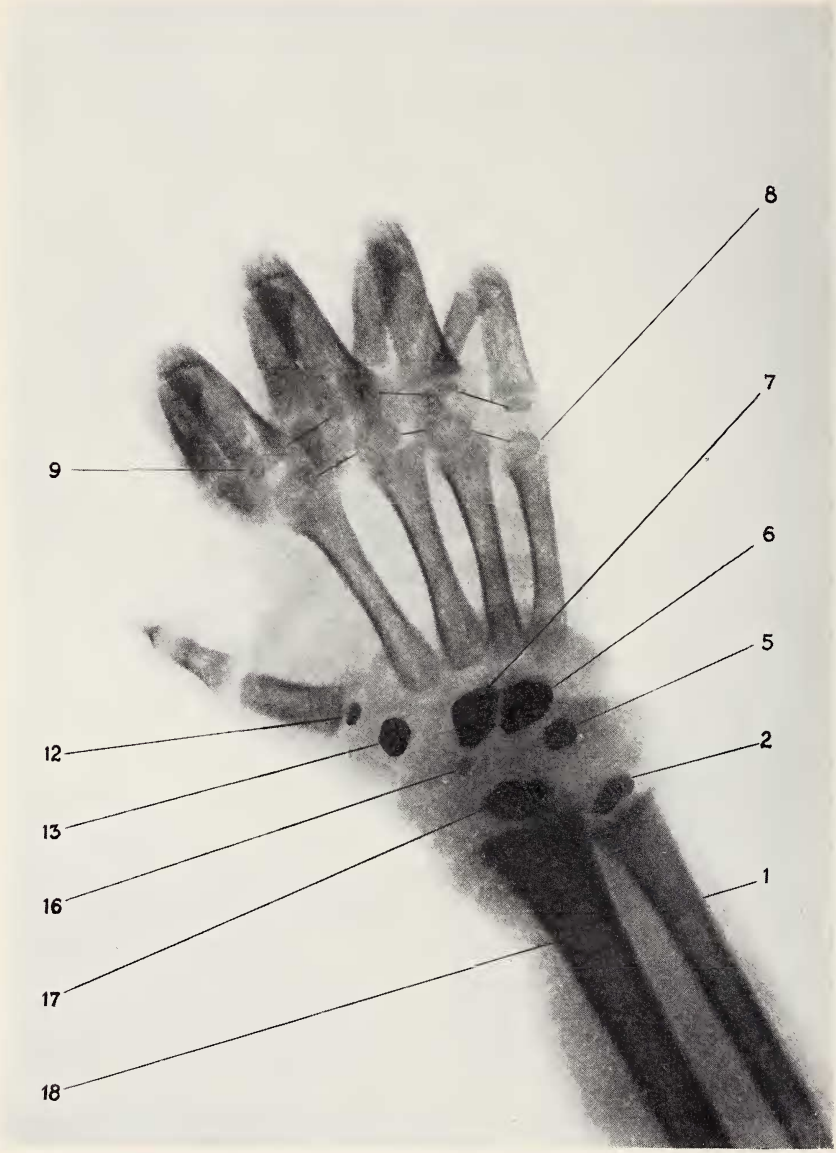

Fig. 63. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

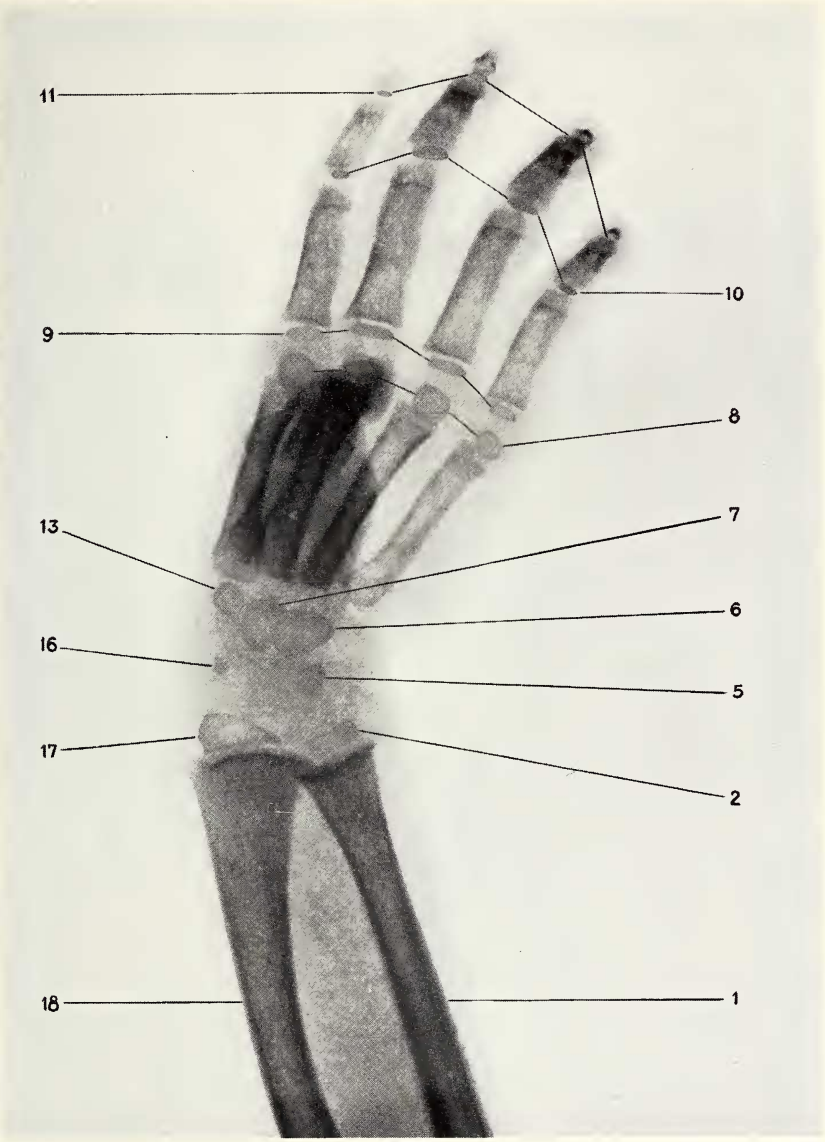

Fig. 64. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 2-3-4-5. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

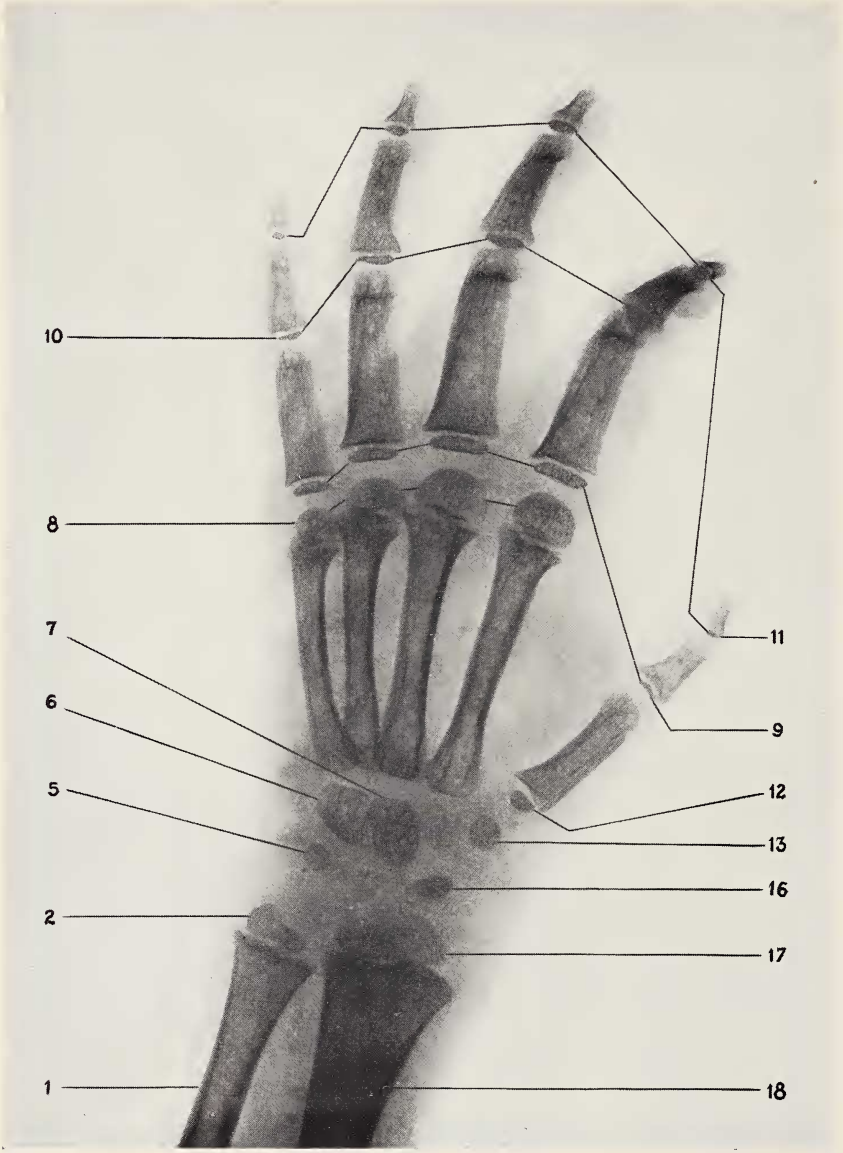

Fig. 65. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

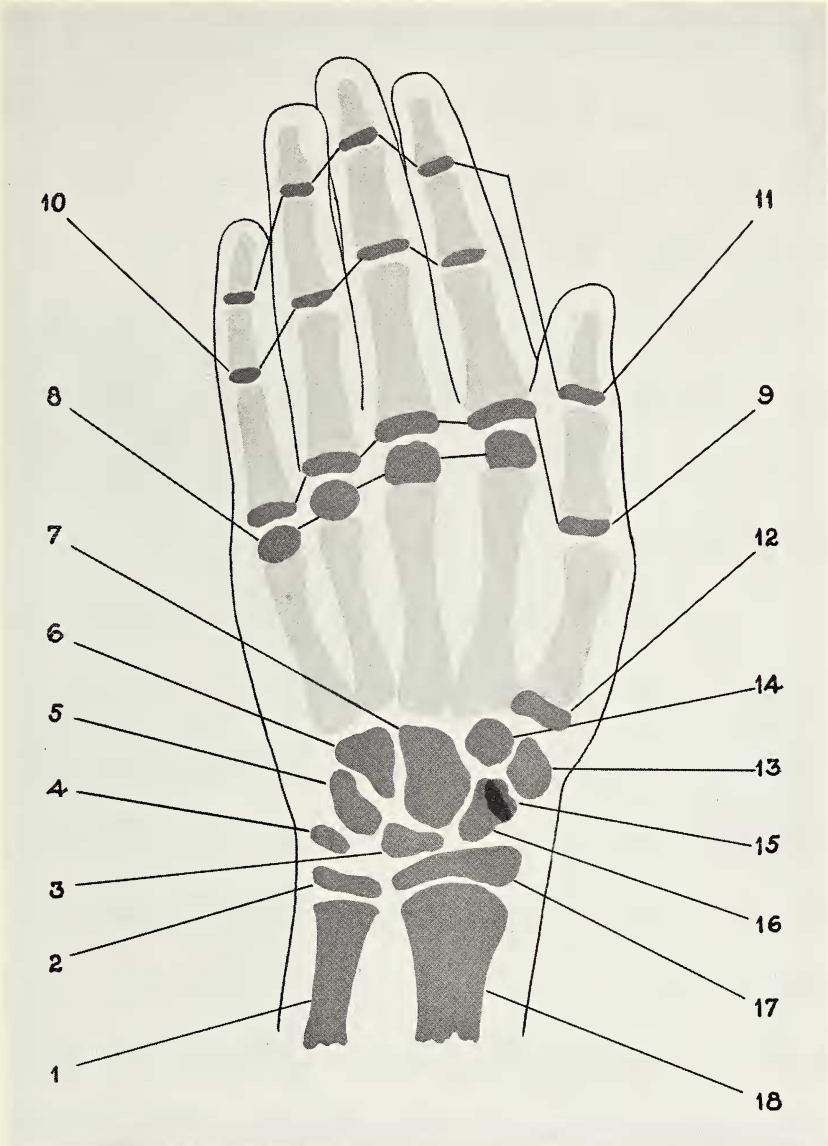

Fig. 66. Outline of Bones of Hand. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

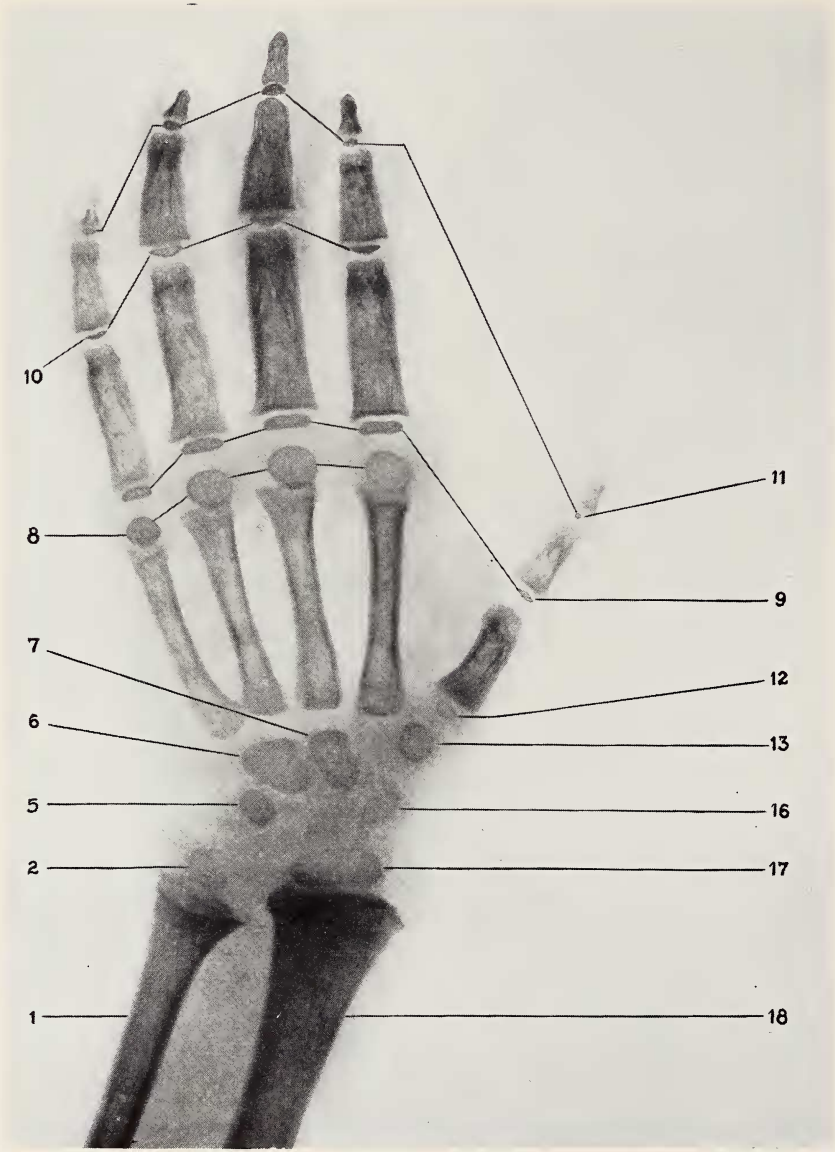

Fig. 67. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

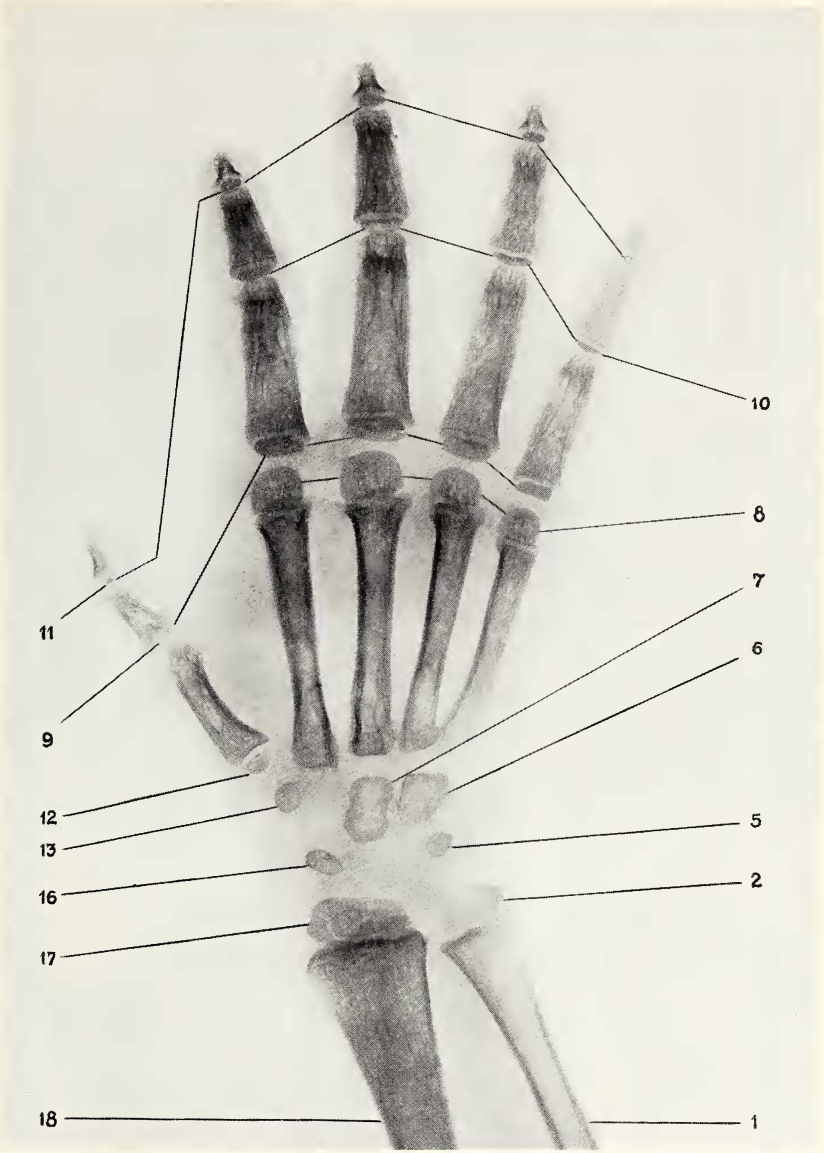

Fig. 68. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

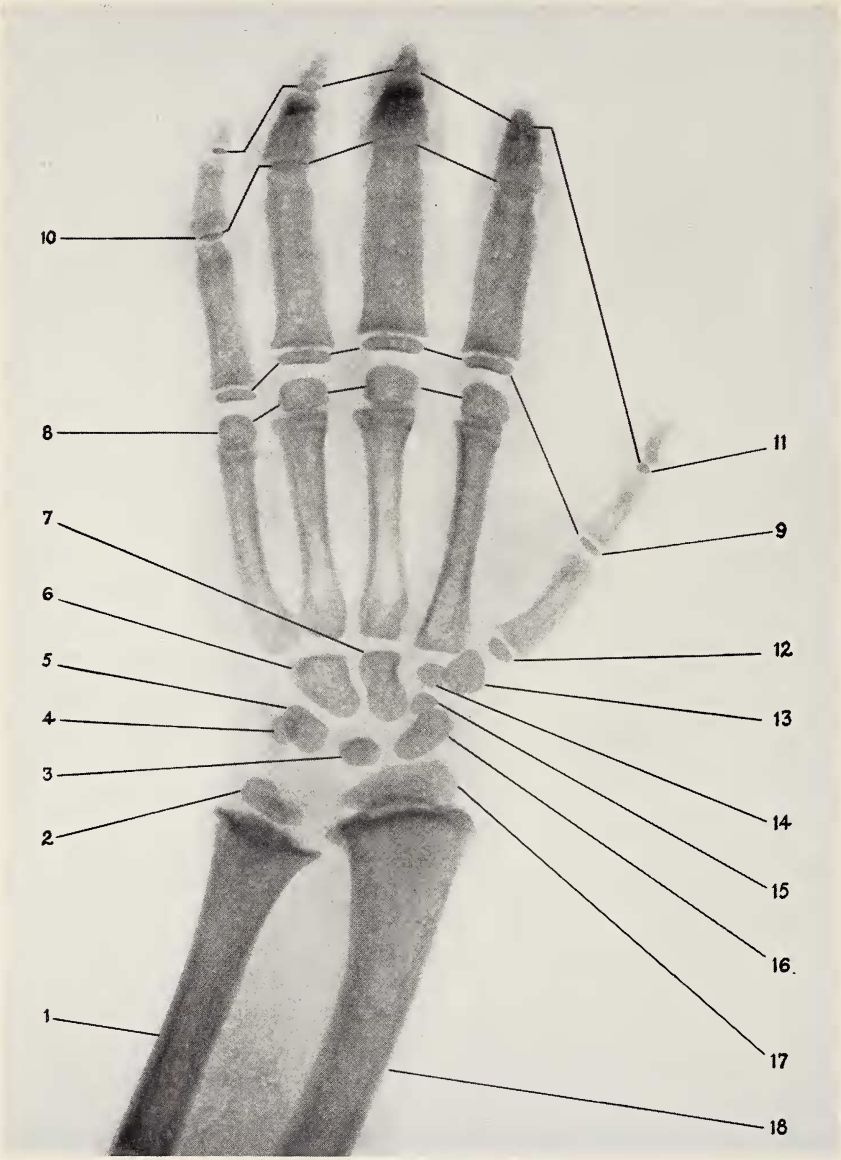

Fig. 69. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

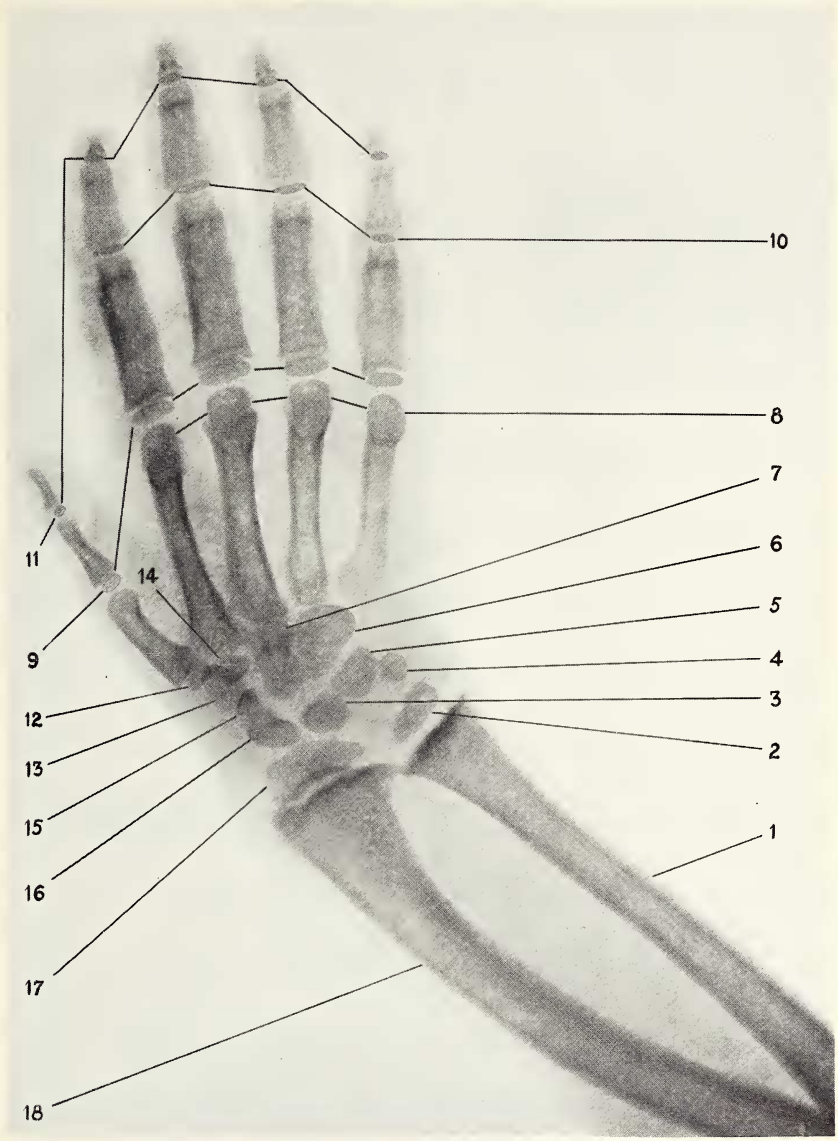

Fig. 70. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

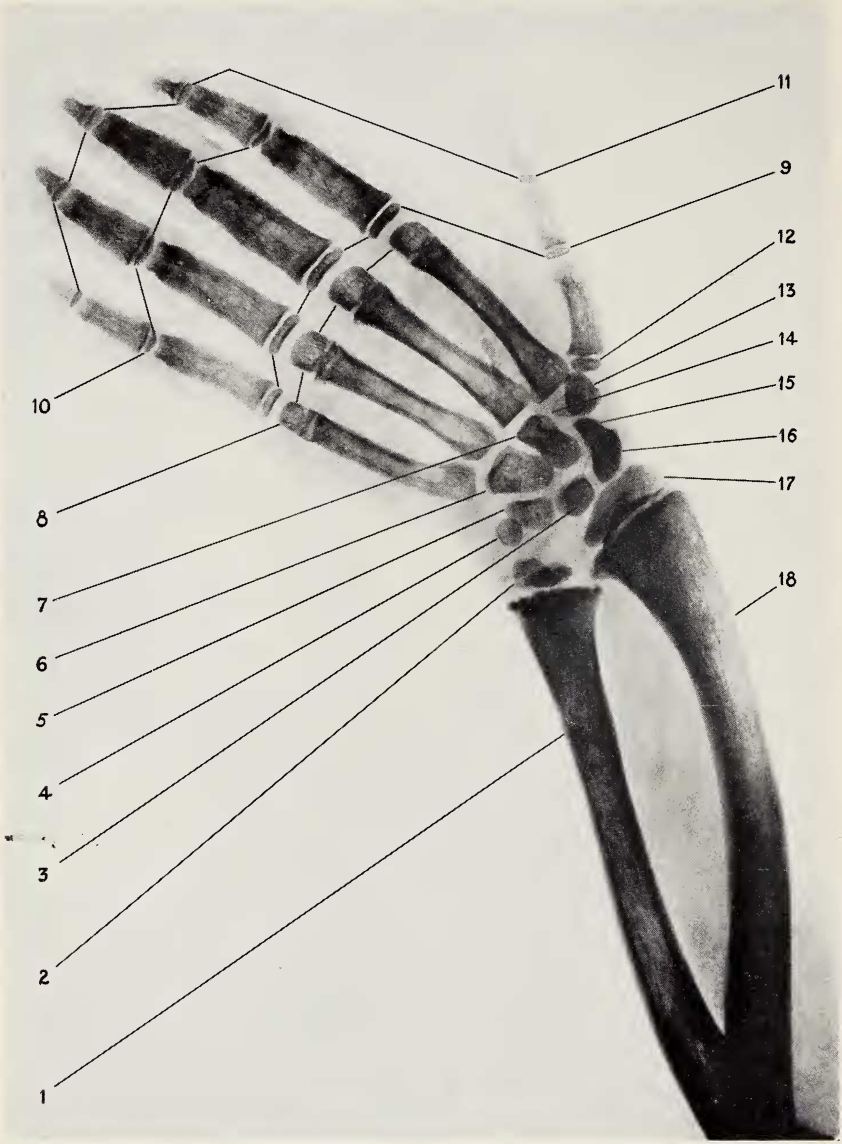

Fig. 71. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

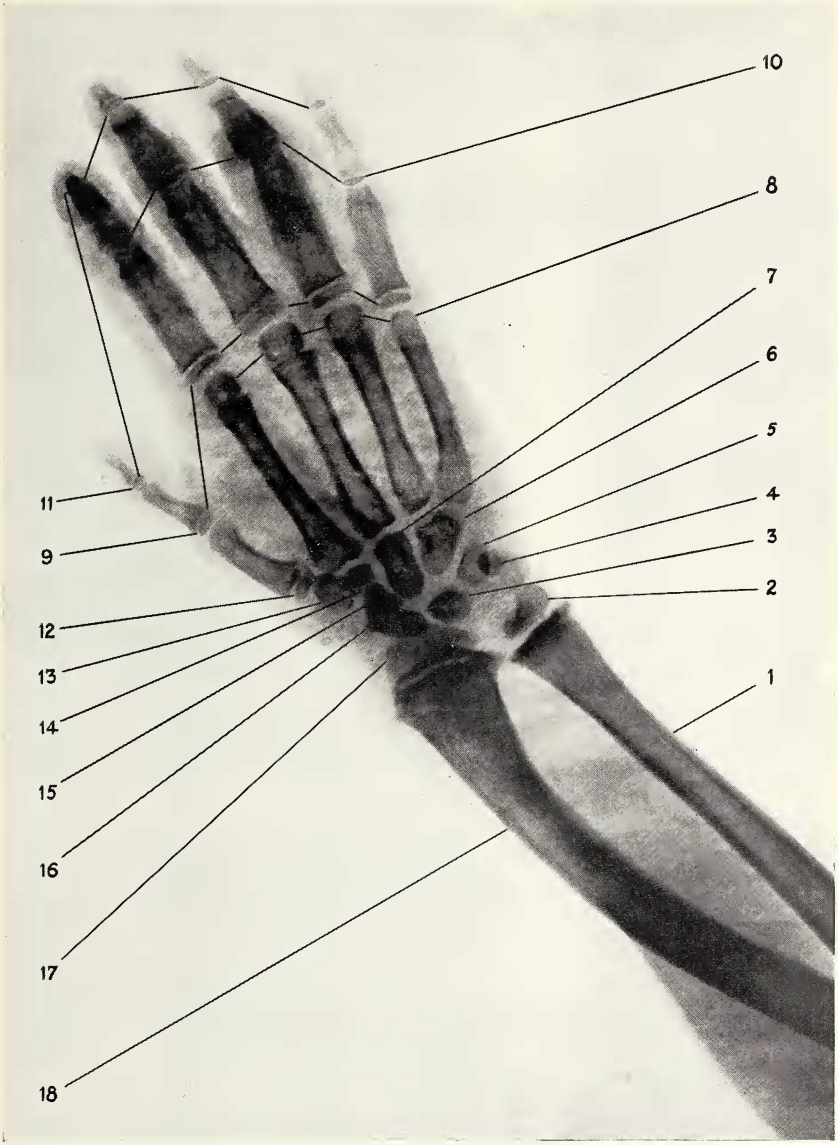

Fig. 72. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT F

CHARLES V. N

	Estimated Age in Months	Sitting Height in Centimeters	Weight in Kilograms	Dentition	Radius	Ulna	E
Stage 1. Specimen 1. C.A. 1105. Figs. 57 and 58	9 to 12	37.5	3.86	8 incisors 4 premolars Total 12	Slight Bowing	Relatively Straight	Ri Le
Stage 2. Specimen 2. Trixie Figs. 59 and 60	14 to 16	41.0	4.66	8 incisors 4 canines 4 1st premolars 4 2nd premolars milk dentition in process of completion See Note #1 Total 20	Slight Bowing	Relatively Straight	Ri Le
Stage 3. Specimen 3. McGregor Figs. 61 and 62	16 to 18	43.5	5.2	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	No Record	N N
11/3/28 Stage 4. Specimen 5. Penserosa Figs. 63 and 64	18 to 20	See Footnote No. 2. No record.	7.84	8 incisors 4 canines (Note #3) 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of No Record	righ
3/10/29 State 5. Specimen 5. Penserosa Fig. 65	24 to 26	47.5	11.10	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of No Record	left R Le
Stage 6. Specimen 4. C.A. 1216 Figs. 67 and 68	24 to 30	53.0	Emaciated 10.9	Full set of milk teeth canines large. Total 20	No Record	No Record	R Le
3/2/30 Stage 7. Specimen 5. Penserosa Figs. 69 and 70	34 to 38	54.5	19.43	The four first permanent molars erupted during February and March 1930 Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	R Le
7/25/30 Stage 8. Specimen 5. Penserosa Figs. 71 and 72	40 to 42	63.5	24.00	Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	R Le

1. The upper right canine tooth has just erupted—erupted—its tip is breaking through the gums. Both upper second premolar teeth (right and left

2.

Date	Leng Crown-
May 18, 1929	72 centi
Mch. 3, 1930	86
Sept. 3, 1930	no recor

3. The canine teeth are not much higher than the

LA, WITH SITTING HEIGHT, WEIGHT, DENTITION AND ESTIMATED AGE
k Zoological Park

tal yses na	Carpal Bones in Probable Order of Appearance	Proximal Epiphyses First Metacarpal	Distal Epiphyses 2-3-4-5 Metacarpals	Proximal Epiphyses First Phalanx 1-2-3-4-5	Proximal Epiphyses Second Phalanx 2-3-4-5	Proximal Epiphyses Third Phalanx 1-2-3-4-5
Right ble	Capitatum (Magnum) Hamatum (Unciform) Total 2	None Visible 0	Spherical and porous 2-3-4 Visible 3	Ovoid discs 2-3-4 Visible 3	None Visible 0	None Visible 0
and sible. arger.	Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and porous. 2-3-4-5. Visible 4.	Ovoid webbed discs in 2-3-4. The 5th is spherical and webbed Visible 4	Ovoid webbed discs. 2-3-4 Visible 3	None Visible 0
tive lear	Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Contracted hand renders Negative poor
ht ble	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Right Visible 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4		Ovoid webbed discs 2-3-4-5 Visible 4
and sible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4
and sible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5.	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
and sible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium) Multangular minor (Trapezoid) Lunatum (Lunar) Pisiforme (Pisiform) Centralia (Centrale) Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
and sible	Same—no fusion of centralia and navicular Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Fusion in right hand Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs. 1-2-3-4-5 Fusion in second Visible 5

e gums. The upper left canine tooth has not quite
lower canine teeth are just coming through the
gums. All the lower premolar teeth (4) have erupted.

Sitting Height Crown-Rump	Span (Lying on Back, Arms Outstretched)
47.5 centimeters	106 centimeters
54.5 "	122 "
63.5 "	130 "